this large and finely illustrated volume is filled, for Prof. Patten has spared no labour in his endeavour to test what seems to him to be an approximate solution of the problem of the evolution of the vertebrates. It may be said at the outset that his theory is quite different from Gaskell's, which, in his judgment, was vitiated by the assumption that the neural surface of an Arthropod is the same as the hæmal surface of a vertebrate.

The general thesis is that "the great Vertebrate-Ostracoderm-Arthropod phylum forms the main trunk of the genealogical tree." Vertebrates arose through Ostracoderms from Arachnid-like Arthropods. One of the important steps was cephalogenesis, numerous anterior metameres being integrated into a "head"—prophetic of the vertebrate head; the old mouth was closed and a new one opened; the bases of the more anterior appendages were forced towards the hæmal surface to form the vertebrate oral arches; the heart was drawn forwards; true gill-clefts appeared; the lateral eye placodes were transferred to the interior of the cerebral vesicle and the optic ganglia to the roof of the mid-brain; and so on.

The Arachnids' forebrain vesicle is formed like that of vertebrates; both have the same sort of pineal eye; Arachnids have a cartilaginous endocranium similar in shape and location to the primordial cranium of vertebrates, and they have an axial subneural rod comparable with the notochord; in Arachnids the brain contains approximately the same number of neuromeres as in vertebrates—these are fair illustrations of the arguments by which Prof. Patten supports his thesis. With his guiding idea of an Arachnid-Ostracoderm-Vertebrate alliance, Prof. Patten feels that the numerous resemblances he adduces have a cumulative convincingness. We must confess that many of them appear to us exceedingly far-fetched, *e.g.* that the "lemmatochord" is comparable to the notochord, and that many others, *e.g.* "endocranium" and cranium, simply illustrate convergence. To the preliminary objection that Arachnids are far too specialised to have given rise to vertebrates, the author gives an answer the point of which we cannot profess to see, that "every animal is a specialised one when compared with its ancestors, and at the same time a generalised one when compared with its descendants."

In regard to the position of other classes involved, Prof. Patten holds remarkable views. The Ostracoderms are intermediate between Arachnids and vertebrates; the Cirripedes are the only members of the Acraniates in which the more typical Arthropod characters are retained; the Tunicates are descended from that particular subdivision of the Arthropods to which the Cirripedes and Copepods belongs; the Echinoderms are also descended from Cirriped-like Arthropods, as may be inferred from the nauplius-like larval form; the Enteropneusta are probably descendants of primitive Arthropods; the Pterobranchs have in certain respects, such as the six pairs of appendages, a decidedly arachnoid character; the Polyzoa may best be interpreted as descendants of primitive Arthropods of the Cirriped type; the Chætognatha are unquestionably primitive Arthropods, somewhat degenerate. Thus we see how the clearing up of the main highway—the Arachnid-Ostracoderm-Vertebrate line—makes the relations of the byways plain! There is much to be said for vigorous heresy, but this is a perversion of morphology. We are minded, however, of the saying of another investigator of the pedigree of vertebrates, that "in morphology everything is important except the hypothesis." In conclusion, we may note that Prof. Patten's researches have made him a convinced "bathmist." The internal processes of differential growth and readjustment are fundamentally important. Environmental influence, natural selection, and the like have played an insignificant subordinate part. "The creative power of internal environment is always present, always active, always changing." We confess to liking this view better than the author's phylogeny.

ZOOLOGY AND NATURAL HISTORY.

(1) *Animal Secrets Told: A Book of "Whys."* By H. C. Brearley. With twelve full-page illustrations from photographs by Elwin R. Sanborn. Pp. xvi+274. (London: Headley Brothers, n.d.) Price 5*s.* net.

(2) *Wild Life in the West Highlands.* By C. H. Alston. With illustrations by A. Scott Rankin. Pp. xi+271. (Glasgow: James MacLehose and Sons, 1912.) Price 6*s.* net.

(3) *The Sheep and Its Cousins.* By R. Lydekker, F.R.S. Pp. xv+315. (London: George Allen and Co., Ltd., 1912.) Price 10*s.* 6*d.* net.

(4) *The Marine Mammals in the Anatomical Museum of the University of Edinburgh.* Part i., Cetacea; Part ii., Sirenia; Part iii., Pinnipedia. By Sir Wm. Turner, K.C.B. Pp. xv+207. (London: Macmillan and Co., Ltd., 1912.) Price 6*s.* net.

(5) *The Growth of Groups in the Animal Kingdom.* By Prof. R. E. Lloyd. Pp. viii+185. (London: Longmans, Green and Co., 1912.) Price 5*s.* net.

"ANIMAL Secrets Told" (1) is a series of popular articles explaining, or attempting to explain, the reason for special variation in the shape and structure of some of the external organs, like the feet, tail, ears, and noses, of certain selected types of vertebrate animals. The book contains much that is instructive and true and suggestive; but some of it is highly imaginative and must not be taken too seriously by the uninformed.

There is not much that is new in Mr. Alston's pleasant little volume (2). It is a collection of essays on a variety of topics ranging from the former existence of the wolf and beaver in Scotland to the value of different colours in the making of anglers' flies. The author is a keen field naturalist, and his ardent advocacy of the protection of indigenous British species of birds and mammals finds expression in the chapters devoted to the sea-eagle, the wild-cat, and members of the weasel tribe. The book concludes with two chapters quite unsuggested by the title. One is upon elephants in Ceylon and the other upon the sheep-killing Kea parrot of New Zealand. In this there is a never previously published account of this bird, supplied to Mr. Alston by Mr. Alexander F. Brown, one of the survivors of the enterprising pioneers of the higher ranges of the South Island.

"The Sheep and Its Cousins" (3) is the outcome of work Mr. Lydekker has been doing for some years in carrying out Sir Ray Lankester's wise scheme for preserving permanent records of breeds of domesticated animals by exhibiting mounted specimens in a special gallery in the Natural History Museum. Mr. Lydekker has made good use of the opportunities afforded by his official position in that institution to get together examples of many rare forms of sheep, about which most zoologists had previously nothing beyond bibliographical knowledge. An account of these, together with descriptions of the principal European breeds and summaries of the highly speculative views of authors touching their origins and affinities, about which practically nothing is known, forms the greater part of this volume, which will form a useful guide for a more thorough and scientific treatise on the subject.

In connection with the oft discussed, but quite unsettled, question of the origin of tame sheep, one cannot suppress a feeling of envy at the assurance with which their differences from wild species are lightly dismissed as due to domestication; and one wonders if Mr. Lydekker realises that his adoption, or seeming adoption, of the view that they are descended from two or more distinct species involves the conclusion that their common characters must have been independently developed at least twice. It may be so; but the evidence for this amounts at present to very little. About the treatment of the wild species, one is at a loss what to say, except that if the author really knows them, apart from their geographical distribution, he has been very unjust to himself. Presumably, the scientifically indefensible inclusion of the Audad (Ammotragus) and the Bharal (Pseudoïs) in a volume devoted to sheep (Ovis), from which goats (Capra) are excluded, is a concession to popular terminology; but since Mr. Lydekker calls them "aberrant sheep" one suspects that he scarcely appreciates rightly the distinguishing characters of these four genera. Naturally, the book is not free from mistakes. For instance, it is stated that the female Bharal lacks at all ages the dark markings of the male. Probably this is never true. Certainly it is not always true. This and other errors, however, will no doubt be corrected in future editions.

(4) In compiling a catalogue of the skeletal and anatomical remains of the Cetacea, Sirenia, and Pinnipedia belonging to the University of Edinburgh, Sir William Turner has taken the opportunity of putting into the hands of zoologists an invaluable monograph containing brief definitions of the families, genera, and often of the species of these three orders, as well as descriptions of the chief osteological, dental, anatomical, and fœtal preparations in the rich collection at his disposal. A surprising amount of information is packed into the two hundred odd pages of the volume, and when one adds that it is illustrated with seventeen plates and more than one hundred text figures, no further evidence need be adduced of its usefulness to students of these orders.

For the classification of the Cetacea, the author has paid special attention to the characters displayed by the fronto-naso-premaxillary region, the rostrum, the hard palate and pterygoids, the teeth and the tympano-periotic bones, and, in the introduction to this order, the principal modifications of these parts of the skull in different genera are briefly detailed. The rest of this introduction contains an account, equally interesting to naturalists and zoologists, of species of whales stranded on the coast of Scotland both in recent times and in the prehistoric period before the land and sea had assumed their present level.

The aim of Dr. Lloyd's book (5) is, as he tells us, to lessen the belief in natural selection as a creative agency, and its pages are devoted mainly to pointing out the variations in colour and other characters presented by the common black rat (*Mus rattus*) in India. Exceptional opportunities for this valuable piece of statistical research work were afforded by the campaign against these pests undertaken by the Plague Commission in 1907, examination of the material sent to Calcutta being part of Dr. Lloyd's work.

He shows amongst other things that variation in the colour of certain areas, especially of the ventral surface and of the tail, is discontinuous and that not infrequently several individuals differ from the ordinary run of rats in a particular district by a combination of characters similar to those used by systematists for discriminating species or subspecies of Muridæ. In the case of *Mus rattus* it is tolerably evident that these individuals are members of a family party; yet, as Dr. Lloyd insists, if a similar series of individuals were to emanate from a "field" species of Mus and were to fall into the hands of a systematist, they would probably be regarded as representatives of an undescribed form and be named accordingly; and in that case they might for ever remain the sole examples of the species or subspecies, so-called. On the other hand, such a series might by isolation in their locality give rise to a persistent type. Dr. Lloyd discusses the question of the origin of "species" from mutants, and expresses the opinion that species have arisen in that way, irrespective of natural selection; and it seems that he would lessen, to that extent at all events, the belief in natural selection as a creative—one would have preferred "guiding" or "fostering"—agency. He also supports his case by citing Tower's records and statistics touching the potato beetle. His views are clearly and modestly put forward, and his book is worth careful attention, although the omission of an index, of a table of contents, and even of headlines to the chapters makes the reading more difficult than it need have been.

R. I. P.

METALLURGICAL INDUSTRIES.

(1) *A Text-book of Rand Metallurgical Practice.* Designed as a "Working Tool" and Practical Guide for Metallurgists upon the Witwatersrand and other Similar Fields. By Ralph Stokes, Jas. E. Thomas, G. O. Smart, W. R. Dowling, H. A. White, E. H. Johnson, W. A. Caldecott, A. McA. Johnston, and C. O. Schmitt. Vol. ii. Pp. xxii+438. (London: C. Griffin and Co., Ltd., 1912.) Price 21*s.* net.

(2) *The Technology of Iron Enamelling and Tinning.* Being Collected Papers. By J. Grünwald. Translated from the German by Dr. H. H. Hodgson. Pp. viii+139. (London: C. Griffin and Co., Ltd., 1912.) Price 6*s.* net.

(3) *Notes on Foundry Practice.* By J. J. Morgan. Pp. ix+108. (London: C. Griffin and Co., Ltd., 1912.) Price 2*s.* 6*d.* net.

(1) THE second volume of this work is by Mr. C. O. Schmitt, and consists of two sections—"The Design and Construction of Reduction Plant" and "The Transport of Material"—the latter naturally being the smaller, occupying the last hundred pages of the book.

The first section deals in a systematic manner with the reduction plant used on the Rand, taking in order the breaking plant, stamp mill, tube mill, sand plant, slime plant, and precipitation plant, and the author has covered this ground very thoroughly, giving much useful information; for instance, when considering the design of a reduction plant, the value of a volume diagram and a flow sheet, in addition to the plan and elevation of the plant, is pointed out. The chapter on "Sorting and Breaking Plant" is good, the subject being fully discussed, while under "Crushing Plant" there is a comprehensive description of the stamp mill found on the Rand, all various parts of the battery being considered.

The section on the modern foundations for mortar boxes is particularly instructive and is well illustrated. The "Nissen" stamp mill, which has recently been run experimentally at the City Deep, is briefly described. A most adequate account of the Rand cyanide plant is given, and it should be of use to all engaged in the cyaniding of gold ores, for the cyanide process has proved a most satisfactory means for the further treatment of the Rand ore, with the result that there have been great developments in the plant. An important chapter on "Estimating" is included, and the author of this volume rightly insists that a detailed estimate of the cost of a plant which has been designed is essential, and for this purpose gives a set of useful schedules.

In the second section of the book the plant for the transport of material is fully described, the methods of handling ore, dry sand, dry slime, pulp and sand residue being given. This section should be of general interest to mining and metallurgical engineers, for the lack of labour on the Rand has made mechanical handling of material a necessity; consequently a large number of appliances is considered.

The volume is copiously illustrated, and contains many useful tables and valuable diagrams as well as a good bibliography.

The work is, as the authors claim, a "practical book for practical men," and, although dealing with the metallurgical practice upon the Witwatersrand, will be of value to those engaged on goldfields where some of the conditions are similar. The advanced student who is studying the metallurgy of gold will find it a useful book, for it will broaden his outlook, give him an insight into industrial problems, and will put before him information gained by practical experience. The book can be thoroughly recommended.